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Industrial Automation by using PLC-based Monitoring and Control System

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Abstract: ***Automation is a set of technologies that results in operation of machines and systems without significant human intervention, which is embedded in the term self-moving so it does not require too much operator intervention and it achieves performance, which is superior to manual operation. So, an automated machine cannot get bored, it cannot make mistakes due to fatigue. It does what it is expected to do each time with the same quality and of course it can also handle things which are much larger, which are not possible to do with human operators so in these senses it can achieve performance superior to manual operations. So that using automation one can cut down costs in various ways from machine to machine, so the faster place a job on a machine. When the machining is done will save in time so the production time will reduce. Typically, various production parameters can be reduced and same way can reduction in material handling time using automation equipment for material handling. The maximum capacity utilization in fact this is the job of an area of research called resource scheduling and finally using automated quality assurance. Main concept of our paper is data acquisition & controlling by using SCADA software PLC.***

Keywords: Transducer, Control System, Programmable Logical Control (P.L.C)

I. INTRODUCTION

Automatic control layers are not manually controlled but from the Supervisory control. The control room is usually a very large room, there are a number of large computer monitors and there are a group of people who are actually sitting around monitors and kind of constantly looking, so they are generally the process supervisors are the operators who perform a lot of supervisory control functions, so at the supervisory control level, there could be some functions which are automated while some functions could be performed manually also. An industrial sensor will obviously find a sensing element; will also find some signal conditioning element. Nowadays because of electronics, the signal conditioning is getting transferred into the sensor itself.

II. GENERAL PRINCIPLES OF MEASUREMENT SYSTEMS:

The sensor or measuring element measures information about the control variable and the information goes to controller where this value is compared with the desired value of the control variable that is set point and error signal generated, depending on this error signal the controller decides what action to be taken so that this control variable is driven to the desired value of control variable. So, controller takes decision it is work as a closed loop system figure 1.

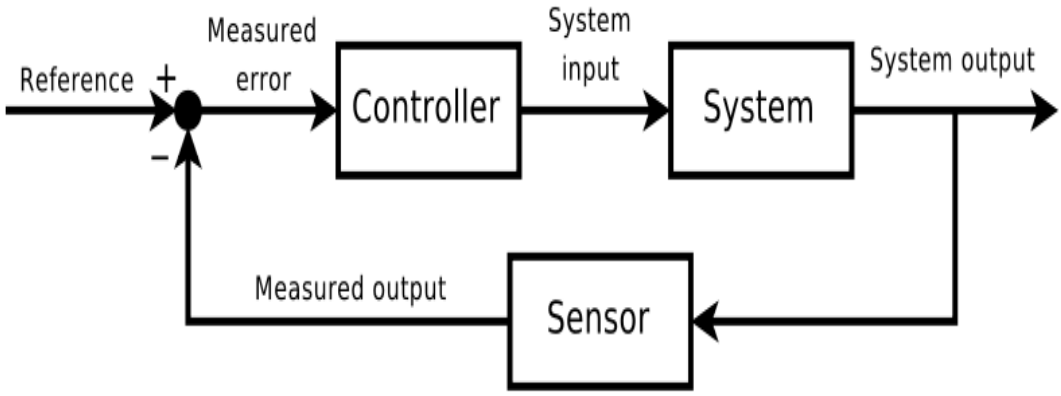

Fig. 1Closed-loop Control System

So, if measure the temperature the information goes to the controller and the controller decides the opening of the control valve. Similarly, also talk about the level control, where use a level indicator which is nothing but a level measuring instrument, which measures the level of the liquid determines whether it is a desired state or not. The information goes to controller the controller decides what is to be done and accordingly changes the opening of valve. So, every control give feedback & control system will have at least one measuring sensor or measuring instrument. Feedback control system is widely used for control of temperature, pressures, flow rates, liquid levels in process industry. Measurement is an essential activity in every branch of science and technology. Measurement means quantification of a parameter or quantification of a quantity or condition. A measuring instrument is thus a device that determines the value of a quantity or condition.

III. TRANSDUCER

Transducer elements are those elements which change the energy from one form to another, let us say a pressure signal is converted to an electrical signal. Displacement signal is converted to an electrical signal so transducer elements are useful in process instrumentation.

A. Thermoelectric Transducer

Thermocouple is a thermoelectric device that converts thermal energy into electrical energy. The Thermocouple is used as a primary transducer for measurement of temperature converting temperature changes directly into EMF. Three phenomenons which govern the behavior of a thermocouple are the Seebeck effect, the Peltier effect and the Thomson effect. If two wires of different metal B and C are joined together to form two functions and if the two junctions are at different temperatures, an electric current will flow around the circuit. This is the Seebeck effect.

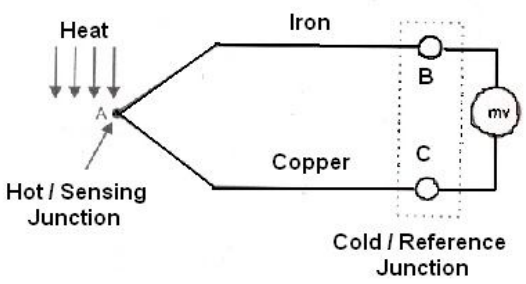

Fig. 2 Seebeck effect

The rivers phenomenon is the Peltier effect. Another reversible heat flow effect called Thomson effect, involves the contribution of EMF to Seebeck EMF in the wire of same metal. If a temperature difference existed within that particular conductor. When a current flow through a copper conductor having a thermal gradient along its length, heat is liberated at any point where the current is in the same direction as the heat flow, while heat is absorbed at any point where these are opposite. In iron, on the other hand, heat is observed at any point when the current flows in the direction of heat flow while heat is liberated when the current flows in the direction opposite to the flow of heat. It will be seen, therefore that the Seebeck effect is a combination of both the Peltier and Thomson effects and will vary according to the difference of temperature between the two junctions. It is essential that no current is allowed to flow in the thermo electric circuit, if the Seebeck EMF is under measurement.

Generally, have two kinds of temperature sensors, one is called a thermistor which is actually a semiconductor resistance and the other is a metallic resistance like resistance temperature detector. Thermocouples which basically on the fact that thermoelectric EMF' generated when one of the junctions of two dissimilar metals are put into a high temperature. So that EMF is measured and used as an indicator of the temperature of the mesh.

B. Resistance Temperature Detectors

Resistance temperature detectors are a simplest these are basically metals and the resistance of a metal varies with temperature. The temperature relationship can be quite complex but it is generally sufficiently accurate. Temperature range is not too large then the response is largely linear. These sensors are very popular and they can be used as more or less. The linear sensors except in certain metals like nickel so, typical metals which are used for example platinum, nickel copper and tungsten. They can be used in various ranges basically depending on environmental conditions and may be depending on melting points of the metal.

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C. Thermistor

The thermistor is actually at any temperature sensitive cells semiconductor register. They have negative temperature coefficient. It is a temperature sensitive device, if increase the temperature his resistance decreases and by using this property mainly it is used as a temperature sensor. It has many applications in electronic circuits. If compare the three basics temperature sensor one is thermocouple, then RTD and thermistor, will find a thermistor has the smallest size and some of the size is so small, sometimes very difficult to even look at the naked eye.

D. Thermocouples

Thermocouples which are based on the principle that if two metals, metal A, and metal B and joined and if these junctions are maintained at temperatures T1 and T2 get an EMF shown on fig.3. This effect is called the See beck effect. There are three kinds of EMF from a physics point of view, there is one called the See beck effect which is the basic effect which is used in the temperature measurement, which says that at the junction of two dissimilar metals and EMF which is a function of the junction. Temperature difference actually exists is the function of junction temperature. So, if have two junctions and two dissimilar temperatures, there'll be two different value of EMF. There will be a potential difference across these two points. There are two other effects associated one is called a Peltier effect which it comes into play when current flows through the junctions and due to the thermoelectric conversion process, the junction temperature may get changed slightly. The EMF can change slightly so the Peltier effect can affect the measurement although; it does negligibly because hardly any current flows through a temperature measurement Junction because they are usually connected to high-impedance point. So, Peltier effect is generally negligible. Therefore, the case of temperature measurement See back effect is the main effect. Thermocouples is active sensors, they generate some source, while this RTD is actually a passive sensor because it requires a power supply. Thermocouples also are very stable and operate, across a large temperature range. They are widely used in the industry.

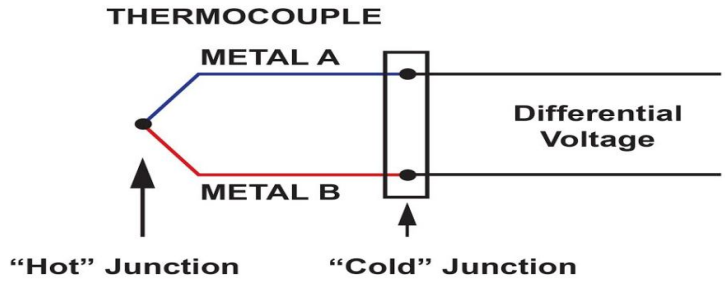

Fig. 3 Thermocouples

IV. PLC

PLC's (PROGAMMABLE LOGIC CONTROLLERS) are real-time embedded systems; they are accept input from the external world and produce outputs which go to the external world namely the machines. Below is a diagram of the system overview of PLC modules in fig. 4.

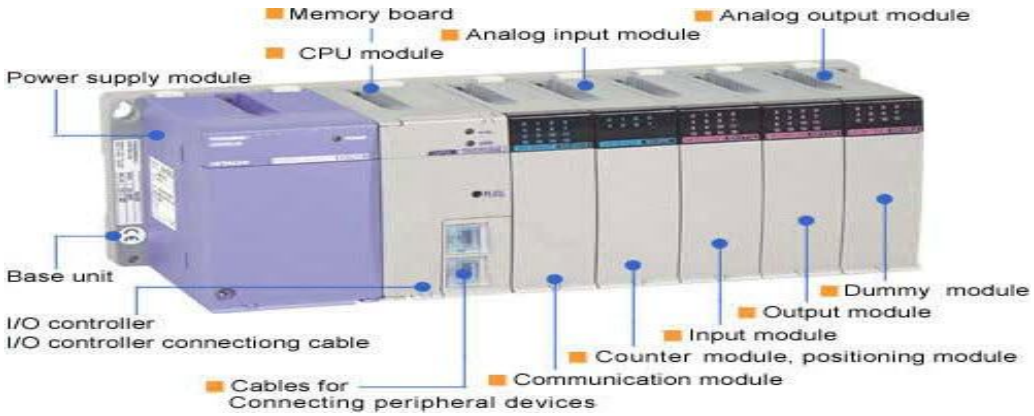

Fig. 4 PLC Controllers

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The PLC program has to be always aware of what changes are taking place in the external world, namely the various variables that are being controlled in the machines. So, a typical program cycle includes three steps. Typically, three activities take place during a program execution; the first one reads all inputs, initially all the inputs are read one after the other and their values are stored and then execution of the logic, so PLC combinations of various section or modules. It has Input unit, Output Unit, CPU and Power supply. All the output controlled by PLC software which can program various PLC programming language. Here fig. no. 5 shows the block diagram of PLC.

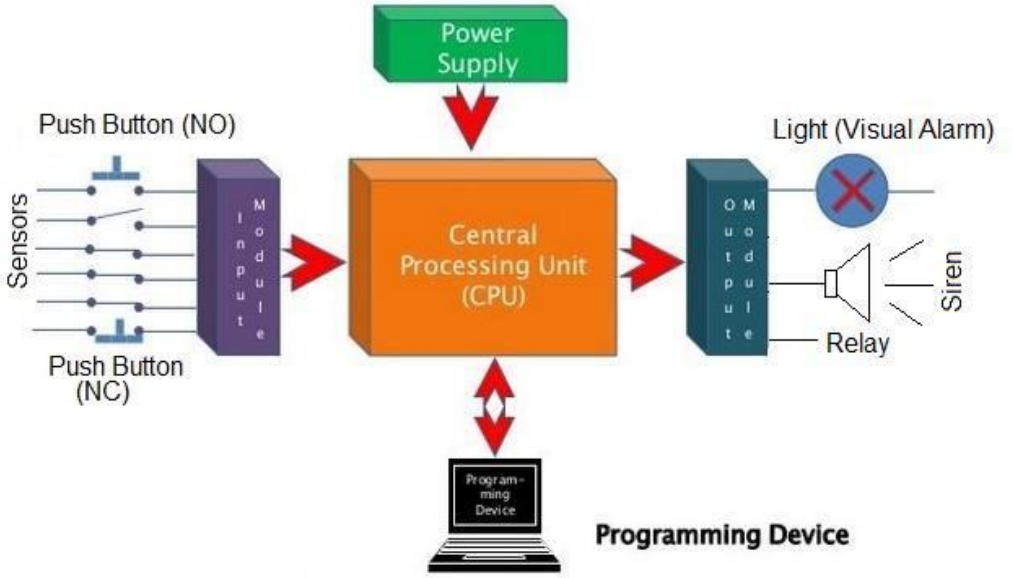

Fig. 5 Block diagram of PLC system

A. PLC Scan Cycle

At the beginning of scan cycle, one cycle of these three steps would be called a scan cycle, in first cycle read all input, second stage execute the plc program as per input and last one is update all output as per program execution output as per shown in fig. no. 6.

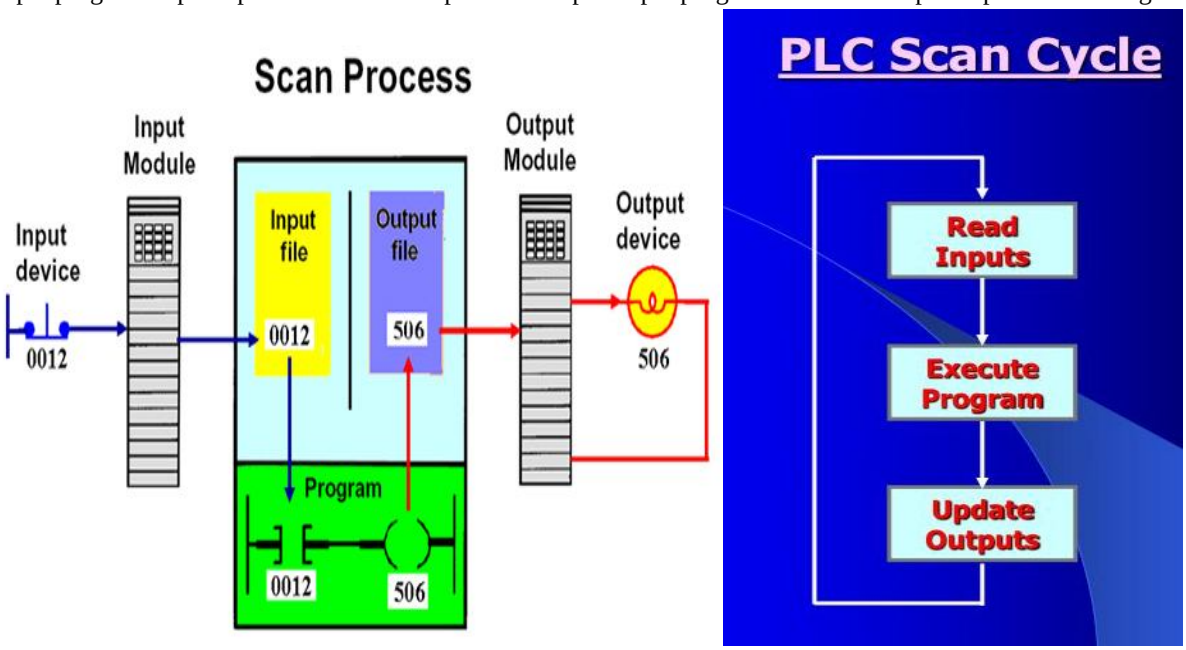

Fig. 6 PLC scan process &cycle

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When the inputs are read for the program logic, these input values will have to be read from time to time during the evaluation of the logic. Therefore, they have to be necessarily stored in memory, so where the input values are stored in memory is called an input image, similarly as outputs are produced and stored transferred to the external world, so for that the output image memory is used. All computations need such certain in addition to the input and output variables these are called temporary variables. A processor reads an input; it actually reads buffer values over the bus. The physical signals keep getting transformed from either to buffers could be physically on the card or it could even be situated in the processor memory. The input was read immediately after it changed, there was no delay in sensing the change in the input. The processor of a PLC made of microprocessors.

B. PLC Programming

The PLC's are nothing but microprocessor-based systems so if see essentially PLC programs are nothing but an assembly language program. People can write them and people can interpret them better without making mistakes so therefore a graphical kind of programming language was evolved. Here is shown the example of PLC programming in fig. no.7.

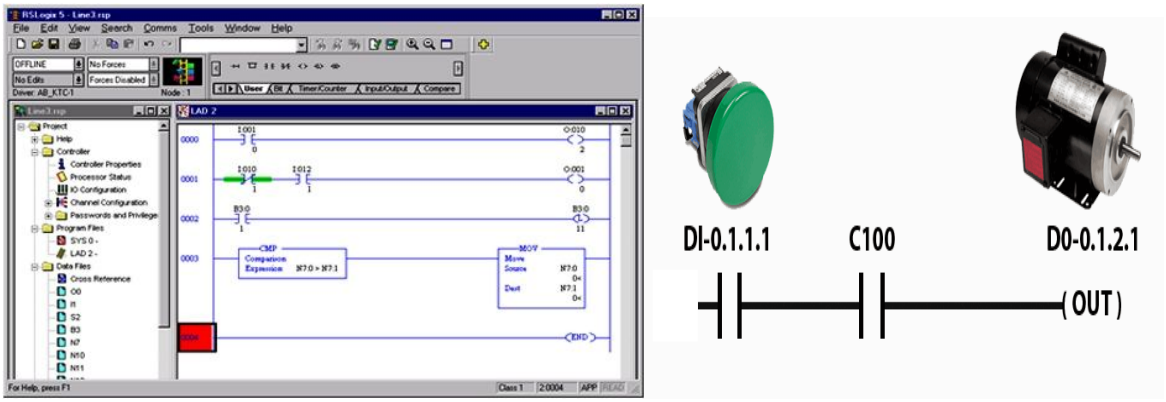

Fig. 7 PLC Ladder Logic programming languages

The typical arrangement would be that there will be a positive voltage bus bar and there will is a negative voltage bus bar and make a combination implement a particular logic a network node, which is a series or parallel. The network makes with series or parallel of various kinds of input devices or many types of transducers, sensors or switches, so under only certain specific conditions of these input devices or switches, there will be a connection from one point to another point and generate the output as per design the plc logic sequence in PLC Software. The following PLC programming languages is used in most of all PLC Manufactures in all over the world.

1) Ladder diagram (LD)
2) Sequential Function Charts (SFC)
3) Function Block Diagram (FBD)
4) Structured Text (ST)
5) Instruction List (IL)

The engineers could think in terms of relays and then using some tool could be transformed to an assembly language. So, behind the PLC programs organized like relay ladders while there is no real end. These relay ladder logic programs are nothing but a series of rungs having between two rails. In Fig.7 shows the Basic Ladder logic programming. A network of the various ladder logic elements like various kinds of contact timers, etc. and followed by an output coil which shows under the output is going to be excited so, one after the other starting from the top after the inputs are read. Program execution is simply executing the logic of the rungs, evaluating the output values from the top one after the other so typical program flow from the top. Individual rungs have several logics and they are all executed between one input read and output write.

C. PLC Input and its concepts

Real physical inputs like some photo detector has detected a part, so it has changed since 0 it has gone to 1, so that input contact will correspond to the physical photo detector device. Similarly, there may be a limit switch or there may be a pressure switch, push button which the user pushes physically, maybe the operator pushes so such contacts will be called input contact which is externally exercised by the machine that means external to the PLC. There are corresponding these contacts there are real physical devices. On the other hand, sometimes use some memory variables as contacts. In PLC programs, there are use two types of contacts the first

kinds of contacts are called NO contacts, NO means normally open similarly so this means that when these contacts are not energized this contact should be open whenever a push button is not pressed. It is represented by an inner contact then when it is not pressed that that contact with the RLL ladder logic is going to remain open. Similarly, as an NC contact where NC stands for normally closed so the same push button if represent it with an NC contact then if the push button is not pressed that is when it is not excited that contact will remain closed. Here fig. no.8 has shown the NO-NC concept in PLC.

Fig. 8 NO-NC Contact in PLC Ladder Programming

So, imagine that have a motor and there are there are two push buttons, one says go forward so the motor will rotate in one way it could be a movement of a motor it could be a move. Movement of a plunger in the forward direction similarly there is another push button which says goes in the reverse direction. If there are two different switches if they are pressed together, then what is going to happen is that the positive terminal and the negative terminal will get shorted this may cause an accident, so by a PLC program provide interlocking so that even if they are pressed together no such problem will occur that types of various future available on plc.

V CONCLUSION

Typical microprocessors, statement execution times run in microseconds, while with PLC's to control either mechanical or thermal or chemical. Industry automation these are mainly three types, one is a distribution control system DCS, second one is the programmable automation control and the third one is programmable logic control which is PLC. The automation having certain advantages like manpower required is less, efficient is higher and safety is higher in automation. There will be no human error because all the process done by the machine. The input be used in a PLC are in the form of two types analog and digital. Input for digital input use push button switch, sensors, selector switches and toggle buttons etc, for analog input use devices like level transmitters, pressure transmitters, temperature transmitters etc. It will give an input like in volts, and ampere will be around at 0 to 10 volts or 4 to 20 milliamps or 0 to 20 milliamps.

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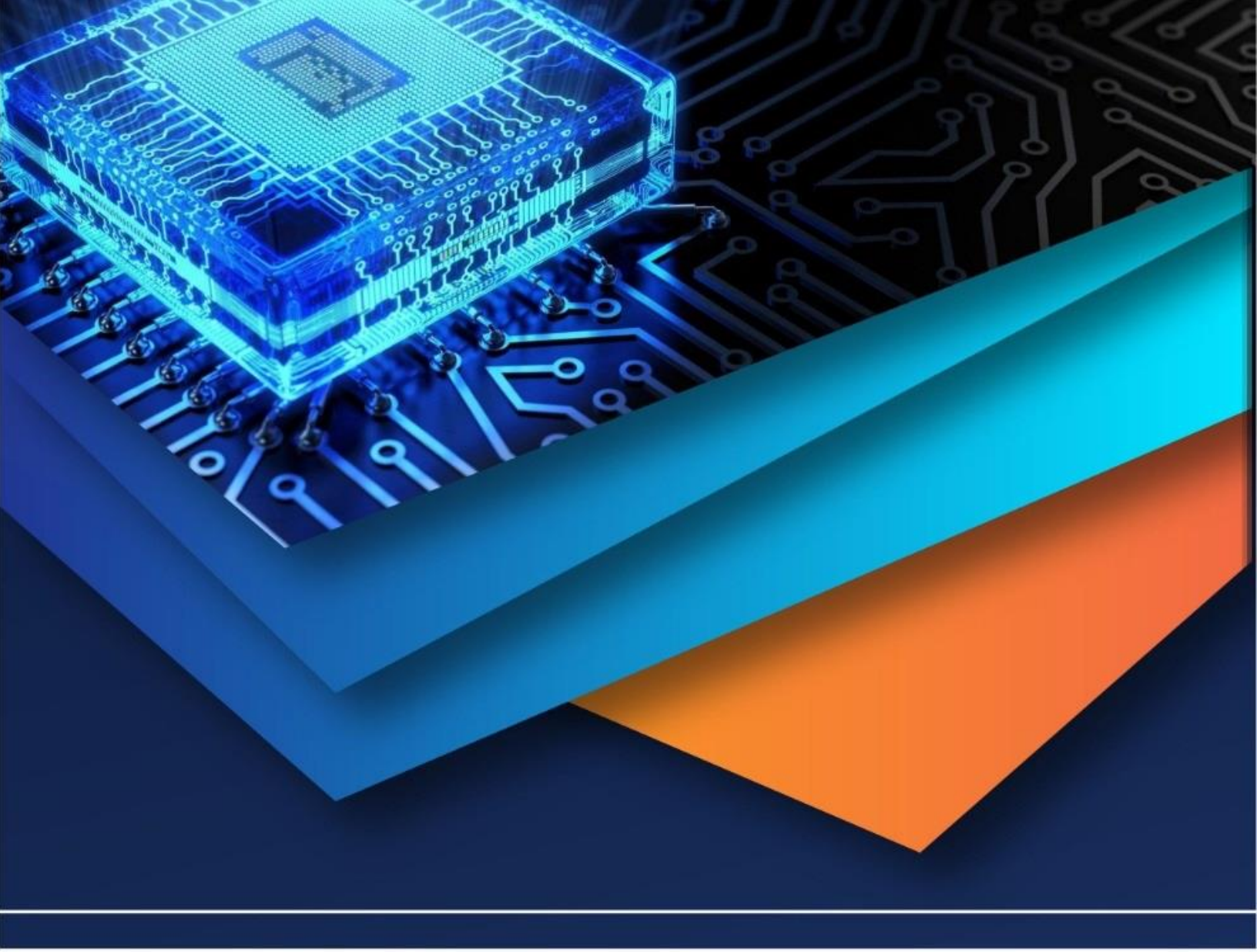

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